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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Ricky Amos

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EXAMINER

LANDAU, MATTHEW C

ART UNIT

PAPER NUMBER

2815

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 09/995,031	<b>Applicant(s)</b> AMOS ET AL.	
	<b>Examiner</b> Matthew C. Landau	<b>Art Unit</b> 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 14 February 2008.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,2,7-11 and 14-17 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,2,7-11 and 14 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Claim Objections***

Claim 1 is objected to because of the following informalities: the limitation “about 5.0 EV” should be changed to “about 5.0 eV”. Appropriate correction is required.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 2, 7-11, and 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeuchi (US PGPub 2004/0080001) in view of Ahn et al. (US PGPub 2002/0155689, hereinafter Ahn) and Huang et al. (US Pat. 6, 248,673, hereinafter Huang).

Regarding claims 1, 2, 10, 11, and 17, Figure 4D of Takeuchi discloses a MOSFET comprising: a semi-conducting substrate (1 or 3B) having source and drain regions 5B; a gate dielectric layer 7B; and a Re-containing gate 12B (paragraph [0079]) located directly on a surface of said gate dielectric. Note that since the gate electrode 12B is made of Re (and therefore has the same structure as claimed), it is inherent that the work function ranges from about 4.6 eV to about 5.0 eV. Where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. *In re Best*, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977). Note that the limitation

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"wherein said Re-containing gate is derived from a  $\text{Re}_2(\text{CO})_{10}$  precursor" is merely a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art.

The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re Thorpe*, 227 USPQ 964, 966.

Takeuchi does not disclose the gate dielectric is  $\text{HfO}_2$ . Figure 13 of Ahn discloses a MOSFET comprising an  $\text{HfO}_2$  gate dielectric 62. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Takeuchi by using  $\text{HfO}_2$  as the gate dielectric material for the purpose of selecting a material known in the art to be used for a gate dielectric. Further, Ahn specifically discloses that it is advantageous to use hafnium oxide as the gate dielectric since it has a high dielectric constant, is thermally stable in contact with silicon, and is resistive to impurity diffusion.

Takeuchi in view of Ahn do not explicitly disclose the thickness of the gate dielectric is less than 50 angstroms. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to further modify the invention of Takeuchi by using a thickness less than 50 angstroms, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). The ordinary artisan would have been motivated to modify Takeuchi in view of Ahn in the manner described above for the purpose of increasing the integration density (by forming smaller devices).

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A further difference between Takeuchi and the claimed invention is the gate has an interface trapped charge density of about  $3 \times 10^{10} \text{ cm}^{-2} \text{ eV}^{-1}$  to about  $4 \times 10^{10} \text{ cm}^{-2} \text{ eV}^{-1}$ . Huang discloses annealing a MOSFET in a hydrogen environment at a temperature of about  $350^\circ \text{C}$  at a pressure of about 700 torr (col. 8, lines 21-46 of Huang). In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Takeuchi by using the hydrogen anneal process of Huang for the purpose of stabilizing interface states and trapped charges (col. 8, lines 54-57 of Huang). After performing the hydrogen anneal taught by Huang, it is inherent that the trapped charge density will be about  $3 \times 10^{10} \text{ cm}^{-2} \text{ eV}^{-1}$  to about  $4 \times 10^{10} \text{ cm}^{-2} \text{ eV}^{-1}$ .

Regarding claims 7 and 14, Figure 4D of Takeuchi discloses the substrate 3B is n-type (paragraph [0064]).

Regarding claims 8 and 15, Takeuchi discloses the substrate can be SOI (paragraph [0068]).

Regarding claims 9 and 16, Takeuchi does not explicitly disclose the substrate is formed of silicon. However, the Examiner takes Official Notice that it is extremely well known to use silicon as a substrate material. It would have been obvious to one of ordinary skill in the art at the time the invention was made to select silicon as the substrate material based on its suitability for the intended purpose.

### ***Response to Arguments***

Applicant's arguments with respect to the pending claims have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew C. Landau whose telephone number is 571-272-1731. The examiner can normally be reached on 9:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Matthew C. Landau/  
Primary Examiner, Art Unit 2815